Site Need Statement

General Reference Information	
1 *	***Need Title:*** Remote Inspection of High-Level Waste Single-Shell Tanks (SSTs)
2 *	***Need Code:*** RL-WT005
3 *	***Need Summary:*** Sixty-seven of Hanford's 149 SSTs are known or suspected to have leaked roughly 1,000,000 gallons of waste to the vadose zone. There are indications that a small amount of this waste has migrated into the groundwater. All of Hanford's SSTs have exceeded their intended design lives and continue to degrade. The *Hanford Federal Facility Agreement and Consent Order* (Tri Party Agreement) schedule requires completion of a saltcake dissolution retrieval demonstration in single-shell tank (SST) S-112 during FY 2005. A crawler based, confined sluicing sludge retrieval demonstration in SST C-104 will occur during FY 2007 with completion of retrieval system construction during FY 2006. The first full-scale combined sludge/saltcake waste retrieval will occur in SST S-102 during FY 2006. Furthermore, under the M-23 Series of TPA milestones, requirements are established for SST integrity assessments. Capabilities for determining the leak integrity and structural integrity of SSTs are required to ensure safe storage of wastes in SSTs awaiting retrieval into the DST system and to assure successful retrieval of the waste from the tanks without causing leakage.
4 *	***Origination Date:*** FY 2000
5 *	***Need Type:*** Technology Need
6	***Operation Office:*** Office of River Protection (ORP)
7	***Geographic Site Name:*** Hanford Site
8 *	***Project:*** Retrieval and Safe Storage PBS No: RL-TW03 and RL-TW04
9 *	***National Priority:*** ___1. High - Critical to the success of the EM program, and a solution is required to achieve the current planned cost and schedule. _X_2. Medium – Provides substantial benefit to EM program projects (e.g., moderate to high life-cycle cost savings or risk reduction, increased likelihood of compliance, increased assurance to avoid schedule delays). ___3. Low - Provides opportunities for significant, but lower cost savings or risk reduction, may reduce the uncertainty in EM program project success.
10	***Operations Office Priority:***
Problem Description Information	
11	***Operations Office Program Description:*** The Retrieval & Disposal Program and the Storage & Closure Program are responsible for Program/Project Planning and Execution; Environment, Safety, Health, and Quality Assurance; Facility Operations; Engineering; Maintenance; Interim Stabilization; and Technology Development, Demonstrations, and Deployments necessary for the safe and cost effective storage, retrieval, disposal, and closure of SST wastes, associated underground storage tanks, and ancillary piping and equipment. Safe storage of wastes includes day-to-day operations of the SST's and DSTs and saltwell pumping operations to remove pumpable liquids from the SST's for transfer to double-shell tanks (DST's) to achieve interim stabilization and minimize the potential for SST leakage. Retrieval projects will be conducted to remove wastes from SST's for placement in DST's in support of waste feed delivery to the Waste Treatment Plant and eventual waste immobilization. An integral part of SST waste retrieval operations is leak detection, monitoring, and mitigation. Safe storage, retrieval, and closure activities associated with SST wastes are also supported by Special Projects and Vadose Zone Projects to characterize groundwater flow and contaminant transport phenomena, geohydrological conditions, and the nature and extent of contaminant plumes.
12	***Need/Problem Description: :*** 67 of Hanford's 149 SSTs are known or suspected to have leaked roughly 1,000,000 gallons of wastes into the vadose zone. There are indications that a small amount of this waste has migrated to the groundwater. All of the SSTs have exceeded their intended design lives and continue to

	degrade. The primary mode of failure has been determined to be stress corrosion cracking due to the lack of stress relieving during tank construction. Historically, the SSTs have leaked at a rate of 1.8 gallons/hr, however, in a few instances, there were catastrophic failures due to steam ruptures that buckled tank bottoms and released tens of thousands of gallons over a short period of time. Although the SSTs are of questionable leak integrity as evidenced by past tank leaks, there are no indications that the structural integrity of SSTs has been compromised using existing inspection methods. Current inspection methods include tank dome video surveys to look for cracking, spalling, and other tank dome anomalies, and tank dome deflection surveys. In addition, tank dome load limits have been established and are enforced to minimize the potential for tank dome collapse. Better methods for determining the leak and structural integrity of Hanford's SSTs is needed. Initially, SSTs that contain little or no waste could be selected for investigation of the tank walls, dome, and floor. If necessary, destructive metallurgical examination of small isolated sections of the SSTs may need to be performed to obtain a thorough understanding of the operating corrosion mechanisms. The number, size, and origin of the cracks that led to the leakage of waste for the leaking SSTs could be determined. Waste leakage rates should be confirmed based on the defect information, and the design of - liquid-based retrieval systems for retrieval operations needs to be evaluated for each selected SST to optimize the design and ensure minimization of leakage potential. Every effort should be made to perform the examination with a device that could be coupled to tank risers, or alternatively, a remote device with robotic features to more efficiently minimize costs. Capabilities to evaluate below the waste level along tank walls and bottom would be highly desirable. The potential benefits of NDE evaluation (and possible destructive evaluation of some of the SSTs) include: • Optimizing the design of liquid-based waste retrieval methods for the SSTs. • Support evaluations of remaining/extended life and use of SST's. • Prioritization and sequencing of tanks for waste retrieval and processing based on suspect integrity. • Urgency with which leak mitigation actions need to be implemented. **Consequences of Not Filling Need:** The DOE has previously entered into a Tri-Party Agreement commitment with Ecology and the U. S. Environmental Protection Agency (EPA) to begin full-scale waste retrieval technology demonstrations in FY 2005. Additional requirements for SST leak and structural integrity inspections are contained in the M-23 Series of TPA milestones. Failure to complete this activity might be construed by Ecology as failure to comply with Tri-Party Agreement commitments, WAC legal requirements, and failure to negotiate in good faith. Furthermore, evaluations of tank leak and structural integrity are necessary to ensure safe storage and retrieval of wastes currently contained in SSTs in a manner protective of human health and the environment. Similarly, understanding of the remaining tank life will support continued safe storage of wastes in SST's until such time it can be retrieved and processed, and support efforts directed towards the sequencing of SST waste retrievals to ensure that problematic SSTs are retrieved first for the greatest risk reduction. ** **Program Baseline Summary (PBS) No.:** TW03 and TW04 ** **Work Breakdown Structure (WBS) No.:** 5.01.02.02 and 5.02.01.01.02.02 ** **TIP No.:** NA
13	***Functional Performance Requirements:*** There are two categories of flaws to consider, non through-wall and through-wall. Non through-wall (partial penetration) needs to be evaluated to estimate the time to wall penetration. Through-wall flaws need to be evaluated to determine the potential for tank rupture and estimate rates of leaks that may occur in the future and assess appropriate actions. Acceptance criteria for NDE has the following allowable flaw sizes: • Through-wall crack length-12 in. • Maximum allowable crack depth-3/16 in. • Thinnest allowable wall section-0.8t (where t is the original thickness) and • Maximum allowable pit depth-0.5t. Ideally, the inspection method will be able to interrogate tank wall integrity at and below the waste level;

	including the tank walls, knuckle region, and dish bottom. **Outsourcing Potential:** Remote inspection capabilities developed at Hanford could be returned to the private sector. Industrial capabilities could be procured either as engineered systems, or as a subcontracted service.
**	**Schedule Requirements:** Functional systems will first be useful if deployed prior to retrieval of waste from the SSTs, which is scheduled to begin by 2005. However, the benefits can be captured even with later deployments. If functional systems can be developed and proven prior to the beginning of actual waste retrieval, then they can become part of ongoing efforts to evaluate SST integrity using such approaches as in-tank video inspections and tank dome deflection measurements. Under the M-23 Series of TPA milestones, a SST In-Tank Surveillance & Monitoring Program Description Document is due by February 28, 2002. SST leak detection and monitoring Functions & Requirements are due by March 31, 2002. A SST System Integrity Assessment Report and Certification are due by June 30, 2002. The technologies and techniques developed and demonstrated in support of this need statement can formulate the baseline for routine tank integrity surveillance activities and support tank waste retrieval system designs and operations.
14	***Definition of Solution:*** The successful solution will have the capability to perform leak and structural integrity inspections on SST tank walls, domes, and bottoms at, below, and above the waste level. The solutions will be able to detect anomalies caused by stress corrosion cracking and other failure mechanisms to the length and depth specifications contained herein.
15 *	***Targeted Focus Area:*** Tanks Focus Area (TFA)
16	***Potential Benefits:*** Liquid-based waste retrieval is considered to be one of the primary methods to retrieve waste from the SSTs. It is possible that liquid-based waste retrieval may not be a viable method for retrieval of some SSTs due to the extensive corrosion experienced by some of the tanks and the potential for causing tank leaks. In such cases, dry retrieval methods may become desirable. Therefore, it is important to initiate tank inspection to rule out liquid-based waste retrieval at an early stage, or implement appropriate leak mitigation measures, to have adequate time to pursue other retrieval methods prior to the 2005 deadline to initiate tank waste retrieval technology demonstrations for SST's.
17 *	***Potential Cost Savings*** $500,000,000 to $800,000,000
18 *	***Potential Cost Savings Narrative:*** Potential cost savings could be on the order of hundreds of millions of dollars by extending the life of SST's, avoiding the cost of building unnecessary new DST's, and possibly allowing the use of less costly waste retrieval methods.
**	***Technical Basis:*** Liquid-based waste retrieval methods that use low volumes of liquids are the current approach for SST retrieval at Hanford (i.e., low volume density gradient saltcake dissolution, robotic crawler-based confined sluicing, and power fluidics). As such, it is necessary to know early what design and operating constraints are necessary to ensure that leakage will not occur during retrieval operations ; including leak detection, monitoring, and mitigation provisions. In addition, current methods for assessing SST integrity are limited to in-tank videos, tank dome displacement measurements, waste chemistry corrosion controls, and cathodic protection. A method does not currently exist for performing leak and structural integrity inspections of SST walls and floors below the waste level.
19	***Cultural/Stakeholder Basis:*** The stakeholders are very concerned over potential waste leakage from SST's during the waste storage period preceding waste retrieval operations. Successful meeting of this need statement will help to support early identification of potential SST integrity issues to ensure proper establishment of priority for waste retrieval activities. Furthermore, knowledge of the potential leak and structural integrity of SSTs will help to optimize retrieval and LDMM system designs and operations.
20	***Environment, Safety, and Health Basis:*** WHC-SD-WM-OSR-005, *Single-Shell Tank Interim Operational Saf Requirements*, WHC-SD-WM-OSR-004, *Aging Waste Facility Interim Operational Safety Requirements*. support documents contain interim operational safety requirements – administrative controls for corrosion cont cathodic protection, tank dome load limits, and integrity assessments. Implementation of these administrative controls necessitates corrosion control activities.

	WHC-SD-WM-PLN-068, *TWRS Life Management Program Plan*, identifies stress corrosion cracking, pitting corrosion, and uniform corrosion as the primary aging mechanisms for DSTs. Studies of failed SST's have indicated stress corrosion cracking as the primary failure mechanism. This is due in part to the fact that the steel tank walls were not stress relieved during construction. BNL/DOE-HQ Tank Structural Integrity Panel, *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks - DRAFT*, discusses the important role of corrosion monitoring in the context of a comprehensive structural integrity program.
21	***Regulatory Drivers:*** DOE-STD-1073-93, *Configuration Management*, requires implementation of a Material Condition and Aging Management Program to control aging processes in major equipment and components. The primary aging processes in waste tank systems are corrosion related. DOE/RL-92-60, *Tank Waste Remediation System Functions and Requirements*, contains corrosion control requirements for the Store Waste (F4.2.1.1) and Transfer Waste (F4.2.4.4) functions. The M-23 Series of TPA milestones establish requirements for SST leak and structural integrity inspections.
22 *	***Milestones:*** *T04-03-341, T04-05-100, T04-06-110, M-23 Series of TPA milestones*
23 *	***Material Streams:*** Sludge, Saltcake, Liquid (RL-HLW-20)
24	***TSD System:*** N/A
25	***Major Contaminants:*** Pu-238, -239, -240, -241; Am-241; U-238; C-14; Ni-59/63; Nb-94; Tc-99; I-129; Cm-242; Sr-90; Cs-137; Sn-126; Se-79; chromium; nitrate; nitrite; complexants (EDTA/HEDTA).
26	***Contaminated Media:*** Tank wastes and vadose zone soils.
27	***Volume/Size of Contaminated Media:*** Nominal capacities of SSTs range from 55,000 to 1,000,000 gallons
28 *	***Earliest Date Required:*** 2/28/02
29 *	***Latest Date Required:*** 9/30/04
Baseline Technology Information	
30	***Baseline Technology/Process:*** There is no baseline technology for in-situ inspection of SSTs to assess corrosion damage. This is due largely to the lack of an annular area (like in DST's) for deployment of NDE techniques. For SST's, integrity is addressed through indirect techniques like waste chemistry controls, cathodic protection, video inspections, tank dome load limits, and measurement of tank dome deflections. Techniques have been developed to inspect tanks at the Idaho National Environmental Engineering Laboratory (INEEL) using an articulated arm and the Alternating Current Field Measurement technology, but these may not be applicable to Hanford Site SST's because the device is not designed to take readings below the level of the waste. The most promising technique may be an adaptation of the Tandem Synthetic Aperture Focusing Technique (TSAFT) for Flaw Characterization being demonstrated in support of DST knuckle-region inspections. The Center for Nondestructive Evaluation has a several methods that may be deployed using tank risers for interrogating the structural integrity of SST concrete domes. This requires further evaluation. Technology Insertion Point(s): N/A
31	***Life-Cycle Cost Using Baseline:***
32	***Uncertainty on Baseline Life-Cycle Cost:***
33	***Completion Date Using Baseline:***
Points of Contact (POC)	
34	***Contractor End User POCs:*** C.M. (Chantho) Creze, NHC, 509-373-0973, F/509-373-6101, Chantho_M_Creze@rl.gov
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*Element of a Site Need Statement appearing in IPABS-IS
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